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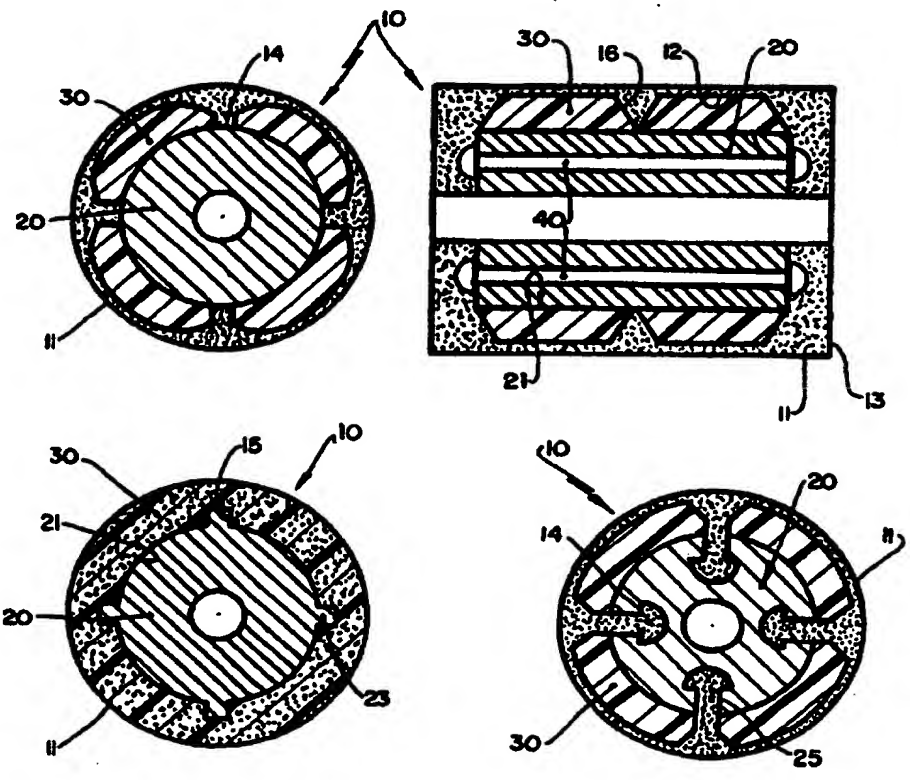
(57) Abstract

A rotor cover for an electric motor, said rotor comprising a rotor core (20) having a lateral surrounding surface and opposite end surfaces; and magnet elements (30) disposed around the rotor core (20) and retained thereon in position by said cover (10), said cover being molded in a single piece, so as to surround at least laterally the core and the faces of the magnet elements (30) which are distinct from those faces seated on the core (20), said cover being circumferentially locked in relation to the rotor core (20) by the interference between at least part of the inner surface of the rotor cover (10) and the outer surface of the rotor core (20).



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A ROTOR COVER FOR AN ELECTRIC MOTOR

Field of the Invention

The present invention refers to a rotor cover for an electric motor of the type used in hermetic compressors for refrigerating systems.

Background of the Invention

The electric motor rotor with permanent magnets comprises magnets which are concentrically mounted to the rotor core and around the motor shaft, and a rotor cover disposed externally to said magnets, so as to maintain them close to said core, avoiding relative radial and circumferential displacements between said parts during the operation of the motor, when the magnets are submitted to centrifugal forces tending to move them away from the rotor core, and to moment (shearing) forces that cause the circumferential displacement of said magnets around the rotor core.

Besides the function of maintaining the magnets close to the core, the rotor cover also avoids the disaggregation and release of magnet fragments resulting from the forces existing thereon, as discussed above.

In a known solution, the rotor cover is in the form of a metallic tube surrounding the magnet-core assembly. Though allowing the magnets to be retained on said core, said solution has the inconvenience of permitting the appearance of induced currents, which cause electric losses and consequently efficiency losses to the motor.

One solution to reduce the effect of these induced currents is to use thin covers obtained from thin stainless steel sheets. However, the thickness reduction required so that said covers do not present a significant electric loss, makes difficult the

handling thereof during the manufacturing process, besides impairing the cover in its structural function.

Other cover solutions are known, such as those covers obtained by surrounding the magnets which are affixed around the core through adequate techniques, by using materials such as kevlar, fiberglass, carbon fiber and adhesive or pretensioned fibers. Though these solutions solve the problem of retaining the magnets to the core, they have some inconveniences, such as providing a structurally fragile cover which will consequently have a reduced useful life, or requiring a delicate and/or high cost manufacturing process, thus being very costly.

Disclosure of the Invention

Thus, it is an object of the present invention to provide a rotor cover for an electric motor, which besides retaining the magnets close to the core during a long useful life, avoids the eventual release of magnet fragments which may be directed to the motor inside and which is industrially viable.

These and other objectives are attained by a rotor cover for an electric motor, said rotor comprising a rotor core having a lateral surrounding surface and opposite end surfaces; and magnet elements disposed around the rotor core and retained thereon in position by said cover, said cover being molded in a single piece, so as to surround at least laterally the core and the faces of the magnet elements which are distinct from those faces seated on the core, said cover being circumferentially locked in relation to the rotor core by the interference between at least part of the inner surface of the cover and the outer surface of the rotor core.

Brief Description of the Drawings

The invention will be described below, with reference to the attached drawings, in which:

Figures 1 and 1a show, schematically and in a cross-sectional view, a rotor cover surrounding different magnet embodiments around a rotor core, according to a rotor cover solution of the present invention;

Figures 2 and 2a show, schematically and in a longitudinal sectional view, a rotor cover surrounding different magnet embodiments around a rotor core, according to the rotor cover solution of figure 1;

Figures 3 an 3a show, schematically, a rotor cover, which includes magnet elements and which is placed around a rotor core, in a cross-sectional view and in a longitudinal section view, respectively, according to another solution of the present invention;

Figures 4, 4a, 4b and 4c show, schematically, and in a longitudinal cross-sectional view, magnet shapes to be disposed around a rotor core in the rotor cover solutions of the present invention; and

Figure 5 shows, schematically and in a cross-sectional view, a rotor cover surrounding magnets around the rotor core and provided with locking projections, according to the present invention.

Best Mode of Carrying Out the Invention

The present invention refers to a rotor cover 10, for an electric motor rotor of the type having a rotor core 20 which is to be mounted surrounding at least part of a motor shaft and around which are seated magnet elements 30, usually in the form of magnetic pieces which are circumferentially spaced from each other and retained against an external lateral surface 21 of the rotor core 20, by actuation of said rotor cover 10.

The covers of the present invention are obtained by molding (injection or casting), including the magnets

(figures 1-2 and 4-5), incorporating the magnets (figures 3 and 3a) or may also be defined by said magnets when the latter are cast around the core. In this last case, the cover is obtained, by directly casting magnetic material around the core or into a mold, thus obtaining a magnetic ring which will be later affixed around the rotor core, by gluing, interference or another appropriate technique. Obtaining the rotor cover by injection may be achieved directly around the rotor core or previously in a mold, said cover being later affixed to the rotor by an adequate technique.

In a constructive form illustrated in figures 3 and 3a, the rotor cover 10 incorporates magnet elements 30 in the form of a particulate magnet material, preferably magnet powder, included in bonding material mass which defines the cover and which will be injected, for example, around a mold inside which the rotor core is found.

In a constructive variant of this solution, in which the magnet elements are incorporated in the cover, the latter may be obtained from rare earths, said magnet elements being bonded together by a bonding material for molding the cover.

According to the constructive illustrated forms of the present invention, around a certain axial extension of the non illustrated rotor shaft, there is concentrically mounted by one of the molding and injection techniques, a rotor cover 10, in order to surround at least laterally the core and the faces of the magnet elements 30 which are distinct from those faces seated on the core 20, said rotor cover 10 having a cylindrical external lateral surface 11 and an internal lateral surface 12, with a shape matching with the shape of the core and/or magnet portion to be

surrounded by said cover.

The rotor cover 10 of the present invention, as illustrated in figures 1-2a, is preferably molded in a single piece and is provided with a pair of end flanges 13, each being seated against a respective end face of a pair of end faces of each magnet element 30 and, preferably, a respective end face of the rotor core 20 extending up to the rotor shaft region, in order to provide the axial locking of the cover 10 in relation to the rotor core 20. In this construction, the cover-magnet-rotor core assembly may, for example, comprise fixation elements 40, such as illustrated in figure 2a, for example.

In order to carry out the present invention, the rotor cover 10 may be provided with end flanges with any extension, ranging from a null extension value, when the cover has only a lateral walls, up to the maximum extension value, as illustrated.

The circumferential locking between the rotor cover 10 and the rotor core 20, in order to avoid the circumferential relative movement between said parts during the motor operation, is obtained by the interference between at least one of the surfaces defined by the inner surface of the rotor cover 10 and an adjacent external surface of the rotor core 20, said surfaces being at least one of the surfaces defined by the lateral surface and by the opposite end surface of each of the parts defined by the cover and rotor core. The interference is achieved by fitting the superficial projections of at least one of the cover 10 and rotor core 20 parts in respective recesses provided in the other of said parts. In a way of carrying out the invention, said superficial projections comprise lateral surface portions surrounding the rotor core, when the latter has a

polygonal contour with a finite number of sides, said lateral surface portions being external to a circumference inscribed in said polygonal contour. In the construction where the superficial projections have an infinite number of sides (circumference), the locking will occur, for example, by superficial projections in the form of radial and/or axial ribs provided in at least one of the surfaces defined by the inner surface of the rotor cover 10 or by the external surface of the rotor core 20, such as illustrated in figures 3 and 3a.

In the rotor cover 10 construction which is provided surrounding the magnet elements 30 in the form of segments seated around the rotor core 20 and circumferentially spaced from each other, the rotor cover 10 incorporates radial ribs 14 defined during the manufacturing process of said cover around the rotor core 20 and magnets 30, as well as from the inner lateral surface 12 of said rotor cover 10, each rib defining a spacing element, against which are seated opposite confronting longitudinal lateral edges of two circumferentially adjacent magnets. The radial ribs 14 occupy at least part and preferably the whole longitudinal extension of the inner lateral surface 12 of the rotor cover 10.

In a constructive variant, the radial ribs 14 are provided from any or both the inner surface of the rotor cover 10 and the outer surface of the rotor core 20, preferably occupying the whole longitudinal extension of the rotor core 20, when said rotor core 20 incorporates magnet spacing elements in its construction. In another constructive variant, the superficial projections further define axial ribs provided from at least one of the parts defined by the end face of the rotor core 20 and by the end flanges

13 of the rotor cover 10.

In the construction of the rotor cover incorporating magnet elements 30, as illustrated, the superficial projections comprise radial ribs 23 which are provided along at least part of the longitudinal extension of the outer surface of the rotor core 20 and which act in respective recesses 15 defined on the inner lateral surface 12 of the rotor cover 10, during the manufacturing process thereof. It should be undestood that the desired locking may be achieved with superficial projections comprising at least one radial rib 23 provided from one of the blades that form the rotor core and thus occupying only a short extension of the outer lateral surface of the latter.

In another constructive form of the present invention, as illustrated in figure 5, the radial ribs 14 act in recesses 25 provided in the body of the rotor core 20, preferably in the form of female locking elements, against which act male locking elements defined by the radial ribs 14 during the manufacture of the rotor cover 10.

The determination of the shape and size of the radial ribs is a function of the rotor dimensions, number of motor poles, flow lines in the rotot, etc., as well as of the manufacturing process (difficulty, costs, etc.). Besides the illustrated shape (figure 5), other constructions which also have good results are those with a polygonal profile having chamfered or rounded corners or which may also have a tapered base.

The rotor cover 10 may further incorporate at least an inner circumferential flange 16, which is radially projected from the inner surface of said rotor cover 10 and which separates, axially, magnet portions 30 disposed along the longitudinal extension of the rotor core 20. The inner circumferential flanges 16 are

dimensioned so as to minimize the removal of magnet material surrounding the rotor, thereby minimizing the electrical losses of the motor.

Besides providing the axial and circumferential locking between the rotor cover and the rotor core, the existing ribs and flanges provide higher structural resistance to the rotor cover 10, since they increase its average thickness and define for said rotor cover 10 a structural cage type shape.

In the rotor cover 10 constructions surrounding magnets 30, for a better durability of said rotor cover 10 and higher retention effect of said rotor cover 10 over the magnets, forcing them against the rotor core 20, the magnets 30 should have a prismatical shape, with vertex portions being cut in order to minimize sharp corners, for example with chamfered or rounded vertex portions, such as illustrated in figures 4 and 4b, being preferred the shape in which the internal and external radii of the magnets are off-centered. In the illustrated constructions having magnets with their internal an external radii being off-centered, the offsetting of these radii is dimensioned in order to minimize the forces over the cover during the motor operation. In this construction, although the shaping of the magnets result in low electrical losses to the motor, it increases the thickness of the rotor cover 10, which improves the structural function thereof.

CLAIMS

1. A rotor cover for an electric motor, said rotor comprising a rotor core (20) having a lateral surrounding surface and opposite end surfaces; and magnet elements (30) disposed around the rotor core (20) and retained thereon in position by said cover (10), characterized in that said cover is molded in a single piece so as to surround at least laterally the core and the faces of the magnet elements (30) which are distinct from those faces seated on the core (20), said cover being circumferentially locked in relation to the rotor core (20) by the interference between at least part of the inner surface of the rotor cover (10) and the outer surface of the rotor core (20).

2. A rotor cover, as in claim 1, characterized in that the interference between the inner surface of the rotor cover (10) and at least part of the outer surface of the rotor core is obtained by fitting superficial projections of at least one of the parts defined by the rotor cover (10) and rotor core (20) into respective recesses provided on the other of said parts.

3. A rotor cover, as in claim 2, characterized in that the lateral surrounding surface of the rotor core has a polygonal contour with a finite number of sides, said superficial projections comprising comprising the lateral surrounding surface portions which are external to the circumference inscribed in said polygonal contour.

4. A rotor cover, as in claims 2 or 3, characterized in that the superficial projections comprise radial ribs (14, 23) provided from at least one of the parts defined by the inner lateral surface (12) of the cover (10) and the surrounding lateral surface (21) of the

rotor core (20).

5. A rotor cover, as in claim 4, characterized in that each radial rib (14, 23) defines a spacing element against which are seated opposite longitudinal lateral edges of two adjacent magnets (30).

6. A rotor cover, as in claim 5, characterized in that the radial ribs (14) occupy at least part of the longitudinal extension of the inner surface (12) of the rotor cover (10).

7. A rotor cover, as in claim 4, characterized in that the radial ribs (23) are provided along at least part of the outer surface (21) of the rotor core (20) and act in radial recesses (15) defined on said cover during its molding, said cover incorporating, in a single piece, the magnet elements (30).

8. A rotor cover, as in claim 4, characterized in that the radial ribs (14) are provided along at least part of the inner lateral surface (12) of the rotor cover (10) in the form of male and female locking elements acting in recesses (25) in the form of female locking elements provided on the rotor core (20).

9. A rotor cover, as in claim 1, characterized in that it is provided with a pair of end flanges (13), each flange being seated against a respective end face portion (22) of at least the magnets around the rotor core (20), in order to provide its axial locking in relation to the cover (10).

10. A rotor cover, as in claim 9, characterized in that the it further has an internal annular circumferential flange (16) which is radially projected from the inner surface (12) of the cover (10), so as to axially separate portions of magnets (30).

11. A rotor cover, as in claim 10, characterized in that the magnet elements (30) have a prismatical shape

with vertex portions being cut in order to minimize the sharp edges.

12. A rotor cover, as in claim 1, characterized in that the production of the rotor cover (10) is achieved by one of the casting and injection processes in a mold carrying at least the rotor core (20).

13. A rotor cover, as in claim 12, characterized in that it is affixed to the rotor core after its manufacture.

14. A rotor cover, as in claim 1, characterized in that, in the condition where the cover incorporates magnet elements (30), said cover is formed of particulate magnetic material which is aglutinated by a bonding material.

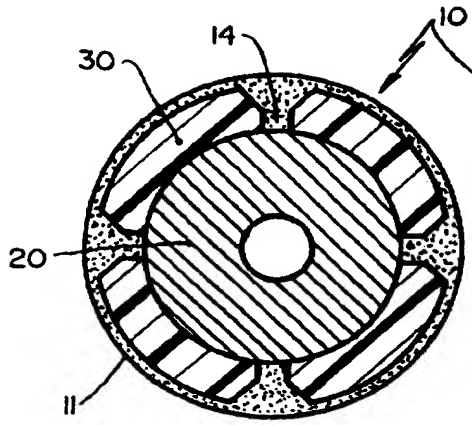

FIG.1

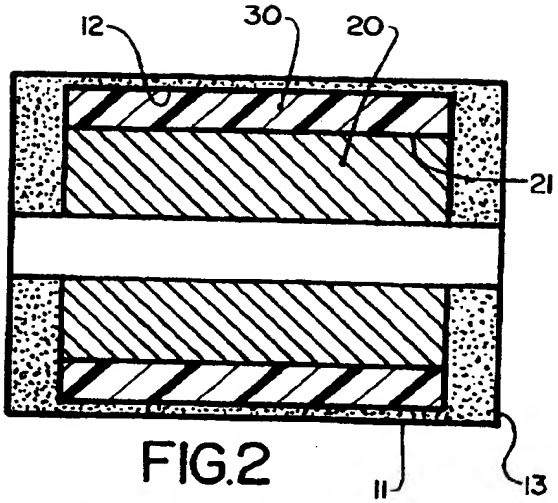

FIG.2

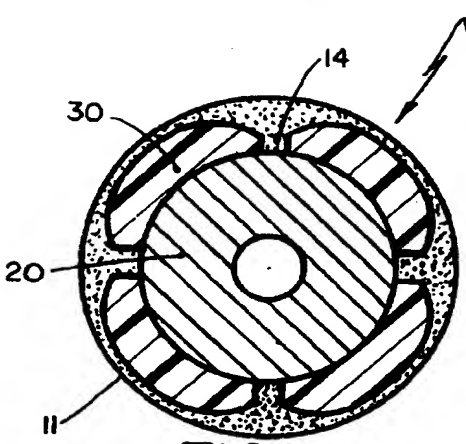

FIG.1a

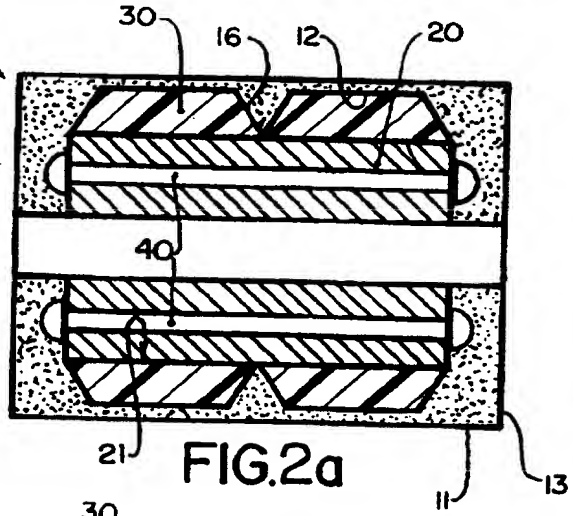

FIG.2a

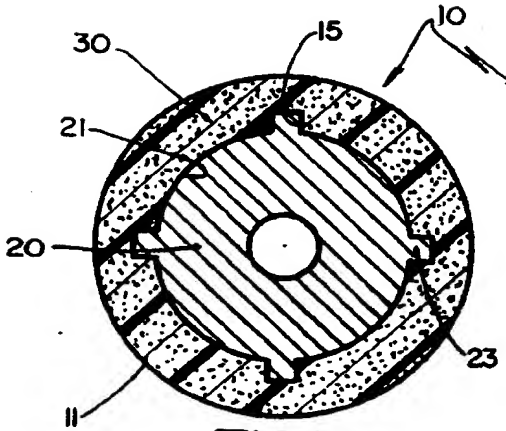

FIG.3

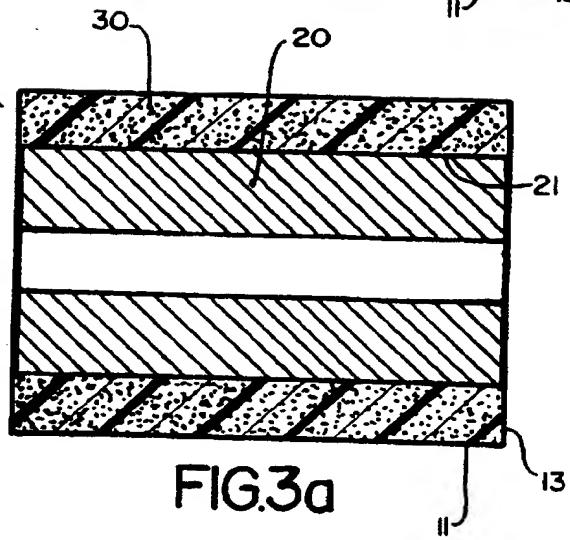

FIG.3a

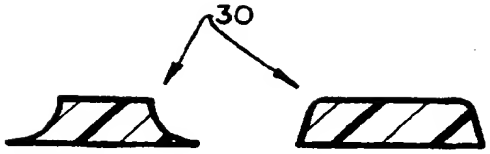

FIG.4

FIG.4a

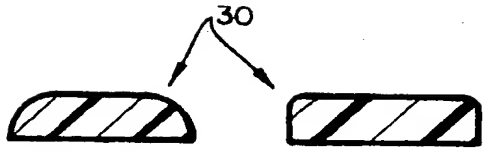

FIG.4b

FIG.4c

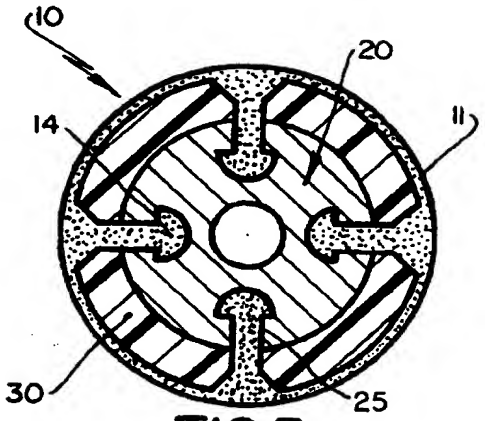

FIG.5

INTERNATIONAL SEARCH REPORT

International Application No PCT/BR 97/00021

A. CLASSIFICATION OF SUBJECT MATTER

H 02 K 1/27

According to International Patent Classification (IPC) or to both national classification and IPC 6

B. FIELDS SEARCHED

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 60-102854 A1 (SANYO) 07 June 1985 (07.06.85), fig. 4. --	1,2,4, 8,9,12
X	JP 61-288758 A1 (SANYO) 18 December 1986 (18.12.86), fig. 1. --	1,9,12
X	GB 2275134 A (JOHNSON) 17 August 1994 (17.08.94), claims 1,3. ----	1,12, 14

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ANNEXE

au rapport de recherche international relatif à la demande de brevet international n°

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JP A2 60102854	07-06-85	keine - none - rien	
JP A2 61288758	18-12-86	keine - none - rien	
GB A1 2275134	17-08-94	GB A0 9302496	24-03-93
		GB A0 9402268	30-03-94
		GB B2 2275134	03-01-96